



Malcolm Baldrige
National
Quality
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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Title: Corrosion Resistance of Weapon Lubricants

PRESENTATION DATE: 11 February 2010

Presenter Name: Joseph Menke

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OUTLINE

1. INTRODUCTION
2. APPROACH
3. RESULTS
4. CONCLUSIONS
5. RECOMMENDATIONS



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- Used animal fat for lubrication as far back as 1400BC
- Oils became available as lubricants in 1859
- Dry lubricant formulations became available in the 1950's

WEAPON SYSTEM LUBRICATION CHARACTERISTICS

- LUBRICITY
- VISCOSITY
- CORROSION RESISTANCE

- LUBRICITY – Falex (at various loads) or 4 ball wear testing with variations in loading were the most common
- VISCOSITY – Numbers at -40 are significant as that is where the weapons are required to function
- CORROSION RESISTANCE – Necessary to insure preservation of function and minimize maintenance

Wear Load Requirements of Specification Lubricants

<u>Specification</u>	<u>Wear/Load</u>
• MIL-PRF-32033	Four Ball – 1mm max. scar
• MIL-PRF-14107	No requirement*
• MIL-L-46000	Four Ball - 4.0 mm max. scar** / Falex - 1500 kg
• MIL-L-46150	Four Ball - 0.5 mm max. scar** / Four Ball - 70 kg
• MIL-PRF-85336	Four Ball - 1.1 mm max. scar / Falex - 2000 kg
• MIL-PRF-63460	Four Ball - 0.8 mm max. scar / Falex - 500 lbs
• MIL-G-21164	Four Ball – Load heat index of 50 minimum***
• MIL-PRF-372	No requirement

* Machine gun firing test shall not reduce cyclic rate by more than 75 rounds per minute

** 250°F vs 167°F, 600 vs 1200 rpm, 50kg vs 40kg load.

***No such requirement in ASTM-D2596

Viscosity Requirements of Specification Lubricants.

Specification

- MIL-PRF-32033
- MIL-PRF-14107
- MIL-L-46000
- MIL-L-46150
- MIL-PRF-85336
- MIL-PRF-63460
- MIL-G-21164
- MIL-PRF-372

Viscosity

7000 cSt at -40oC
950 cSt at -54oC
12,000 cSt at -54oC
120,000 cSt at -54oC
70 Pa-s at -55oC
5000 cSt at -40oC
-
1500 cSt at -29oC

Salt Spray Test Results (ASTM-B117) on Bare Steel – Time to failure in hours

<u>Material Tested</u>	<u>Time to Failure</u>
• MIL-PRF-37215 (Rifle Bore Cleaner)	2
• MIL-L-46000 (LSA)	2
• MIL-L-14107 (LAW)	6
• MIL-PRF-63460 (CLP)	120-160
• VV-L-800 (MIL-PRF-32033)15	3-8
• CLP (Commercial lubricant) (4000 ppm CI) (C)	2
• CLP (Commercial lubricant/preservative) (S2)	24-48
• CLP (Commercial lubricant/preservative) (1200 ppm CI) (S2L)	8
• CLP (Commercial cleaner/lube/preservative) (H)	2

SALT SPRAY HOURS

Material Tested

• Commercial Lube (B)	
• MIL-C-16173, Grade 2	192-216
• MIL-L-3150	40-75
• Commercial Rust Preventive Oil (CX)	31-48
• Commercial Rust Preventive Oil (CXHD) (12-16 mils)	2000-3000
• Desert Storm Lube	2
• Iraqi Freedom Lube	2
• Vietnam Lube	20-24

SALT SPRAY HOURS

Material Tested

• MIL-C-40084 K (10% oil-90% water)	3
• MIL-C-40084 DT (10% oil-90% water)	6
• Commercial F (10% oil-90% water)	4
• Commercial F (20% oil-80% water)	48
• Commercial P (10% oil-90% water)	2
• Commercial P (50% oil-50% water)	48
• Commercial F1 (50% oil-50% solvent)	24
• Commercial F2 (50% oil-50% solvent)	6



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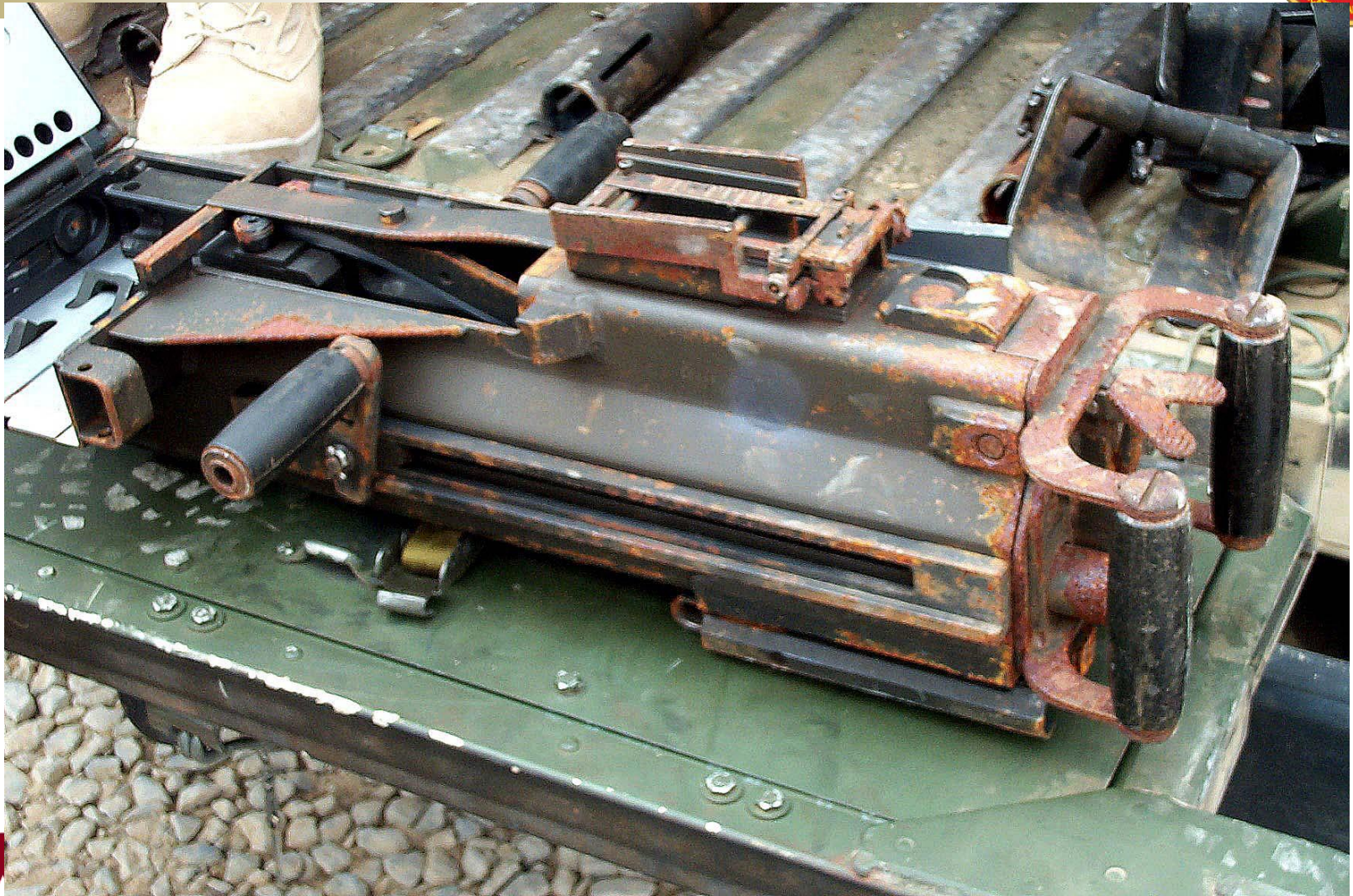


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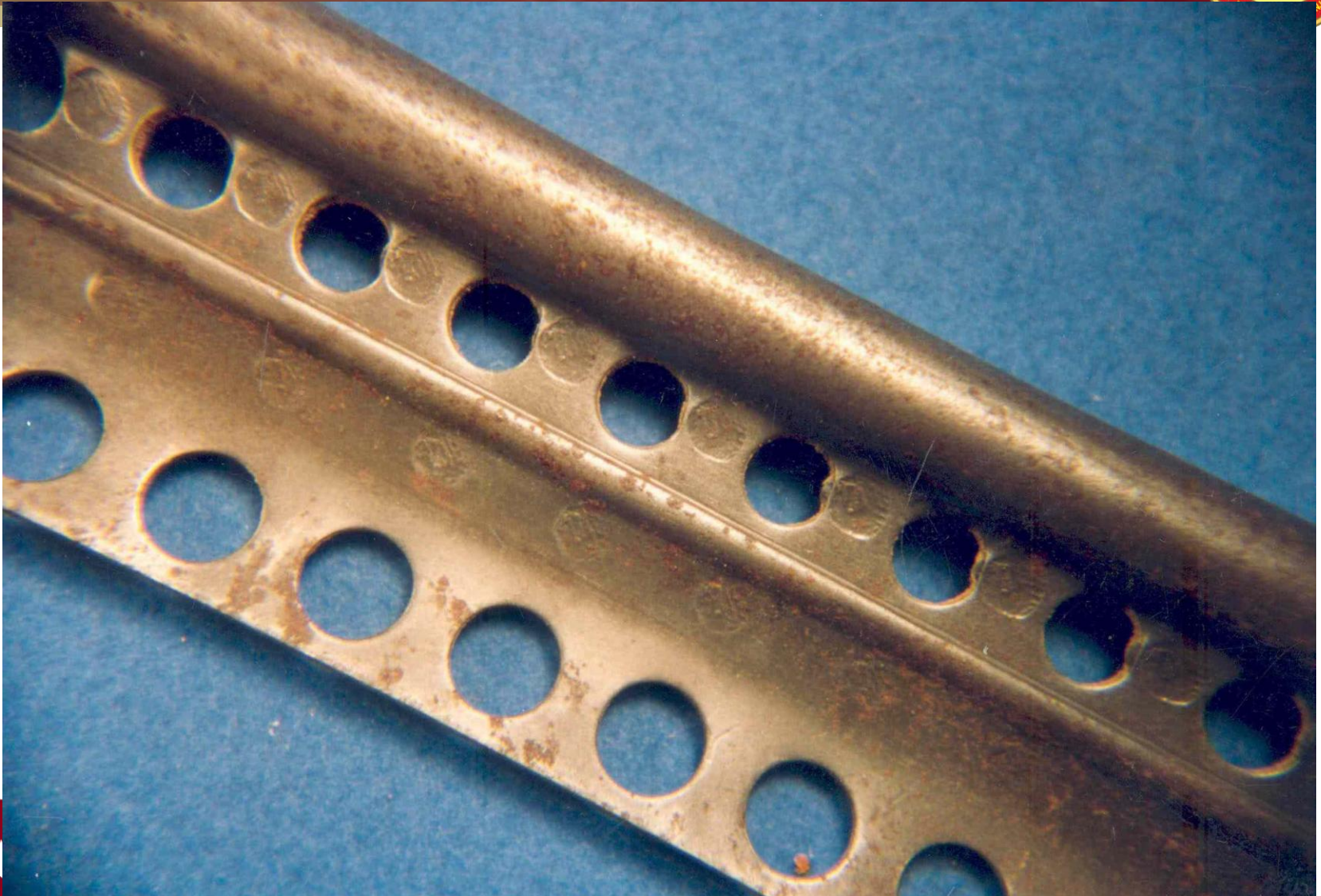
RETURNS-DESERT STORM



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RETURNS-DESERT STORM



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A letter from the PUBLISHER

James R. Shepley

TIME, APRIL 26, 1968

A minute gesture or item, such as the pencil reproduced in actual size on this page, can sometimes acquire great value. That is just what happened when a voluntary organization asked G.I.s in Viet Nam what their

most-wanted items were. Those needs were modest—such things as a pair of dry socks and some writing material. TIME provided the tiny pencil, which the Christian Reform Laymen's League included in 200,000 packets to Viet Nam. Surprisingly, the minipencil is serving purposes far beyond postcard writing. Its wooden shaft, wrote one Marine, is being used to clean the hard-to-get-at rifle sights, while the graphite helps sliding parts of the M-16. Hearing



TIME—The Weekly Newsmagazine

of this, the volunteer group asked TIME for more of them to be included in a second shipment. This week another 200,000 pencils are going to the men.



Table I. Properties of Common Lubricating Pigments

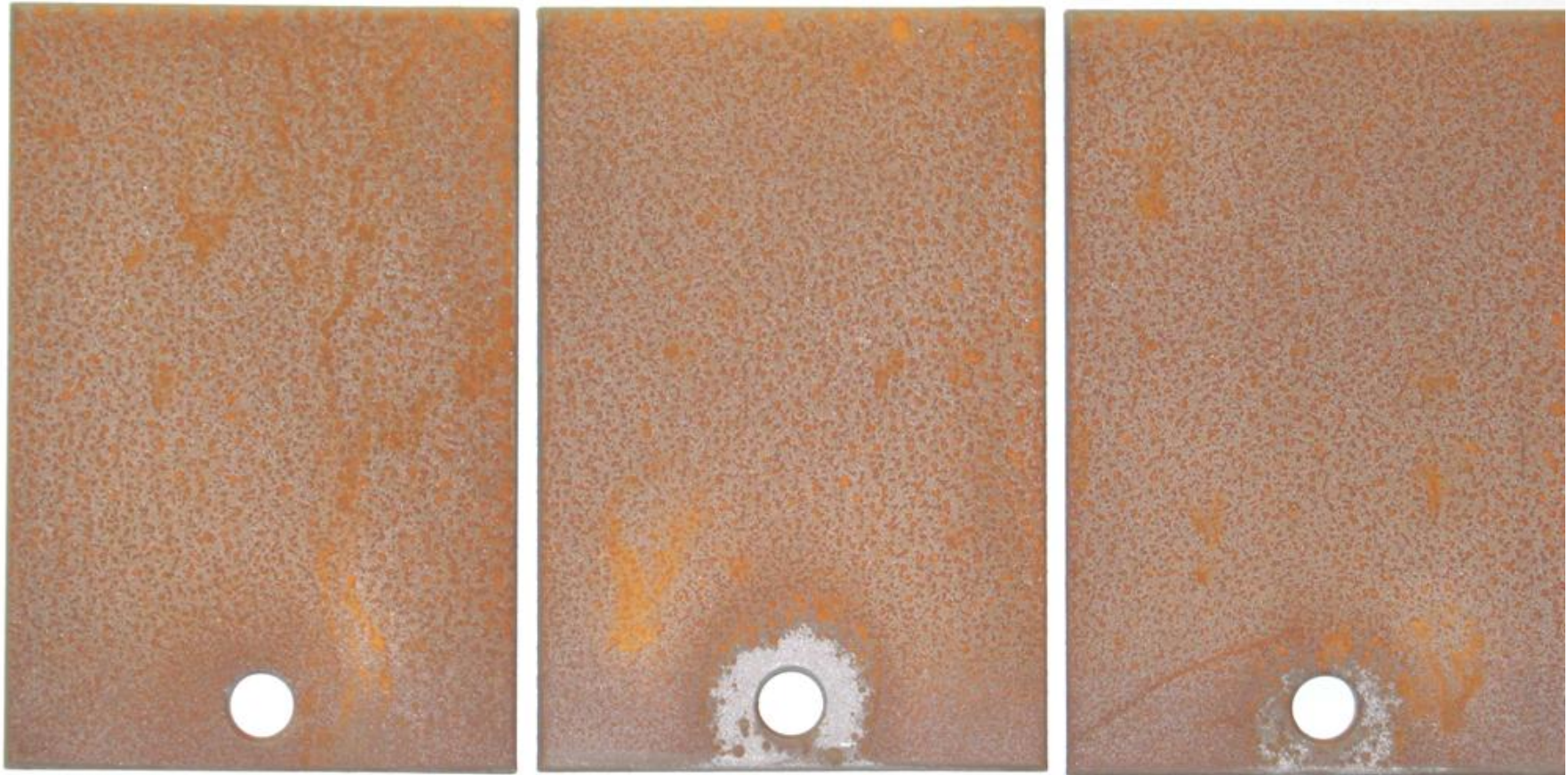
<i>Pigment</i>	<i>Color</i>	<i>Load Carrying Capability (psi)</i>	<i>Thermal Stability (°F)</i>	<i>Corrosion Resistance (0.5-2.0 mil)</i>
Molybdenum disulfide	Gray-black	>100,000	Good (<750)	Very Good
Graphite	Gray-black	<50,000	Excellent (<1200)	Fair/Poor
Polytetrafluoroethylene (PTFE)	White	<6,000 (1500)	Fair (<500)	Good
CLP oil w/ PTFE	light tan	750	150	GOOD
	<i>Typical Particle Size (μm)</i>	<i>Vacuum Suitability</i>	<i>Moisture Sensitivity</i>	<i>FALEX @1000 lb gage</i>
Molybdenum disulfide	2-6	Yes	Detrimental	> 450 minutes
Graphite	2.5-10	No	Necessary	> 60 minutes
Polytetrafluoroethylene (PTFE)	Submicron	Yes	No effect	< 1 minute

Table II. The Effect of Pretreatment on Wear Life

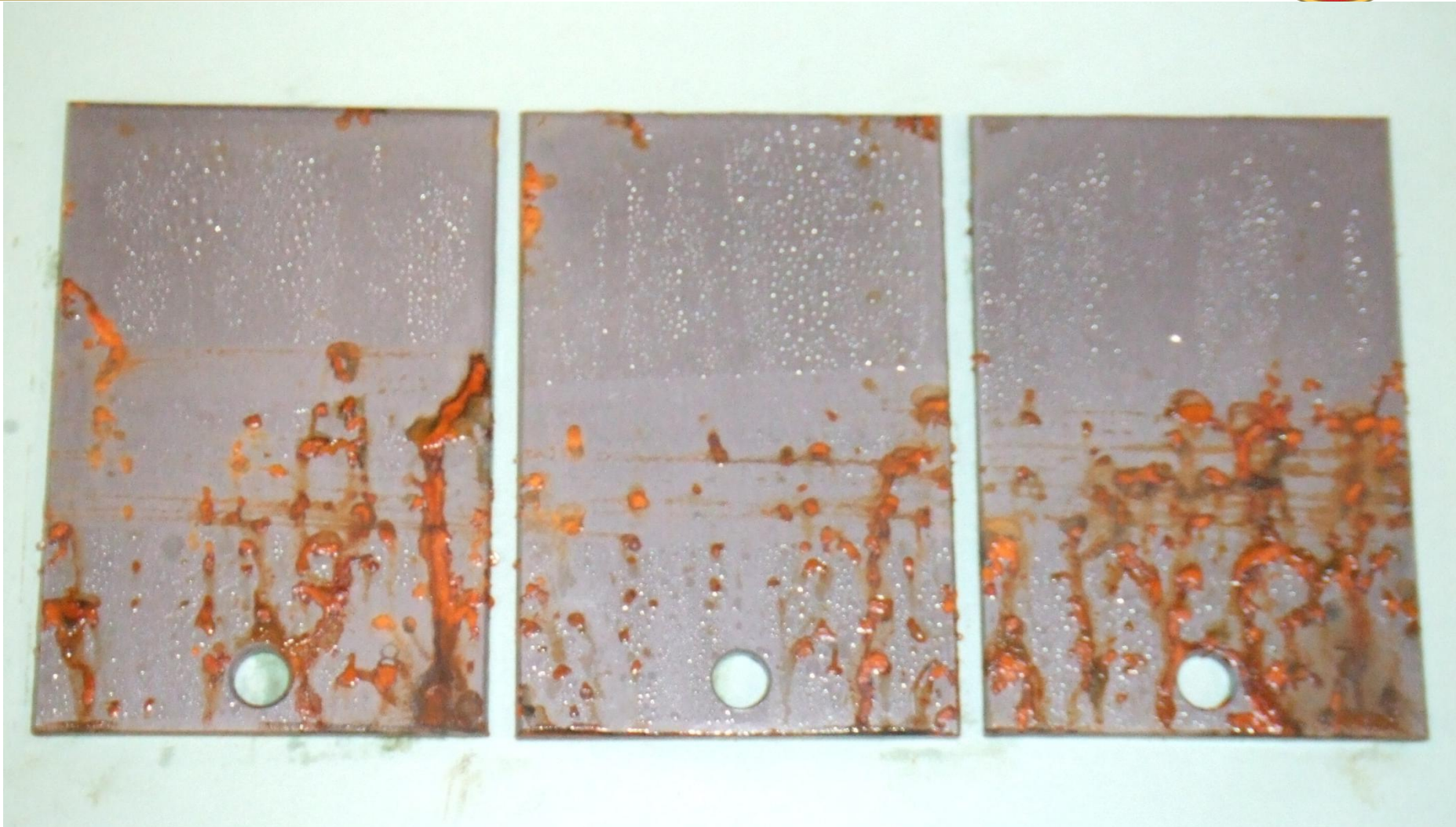
<i>Pretreatment</i>	<i>LFW-1 Test ASTM D-2714 → 72 RPM and 630 lb load ± 100,000 psi</i> <i>Cycles to Failure</i>
None	Failure on loading
Vapor degrease/Sand blast	20,000
Vapor degrease/Sand blast/Phosphate	672,000

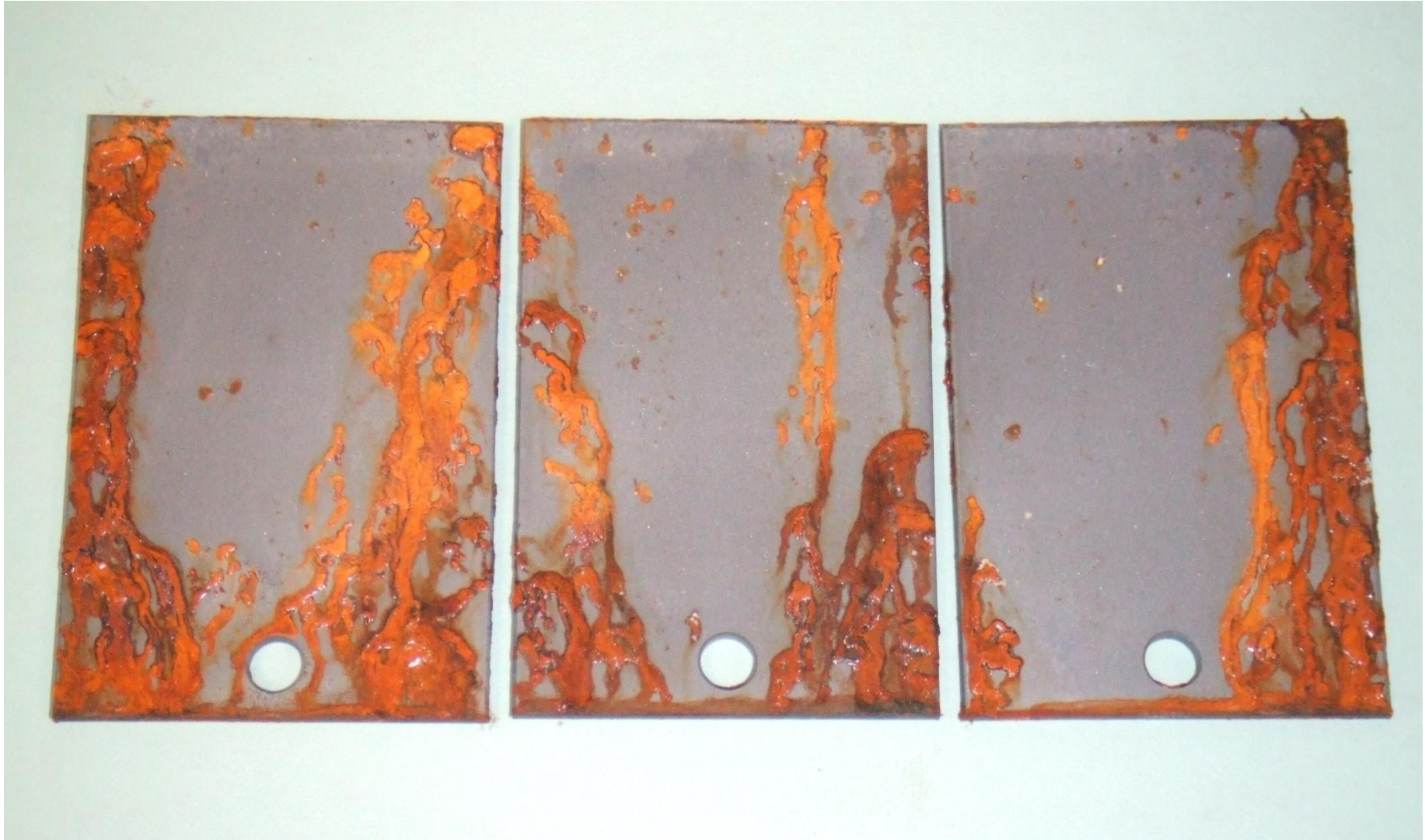


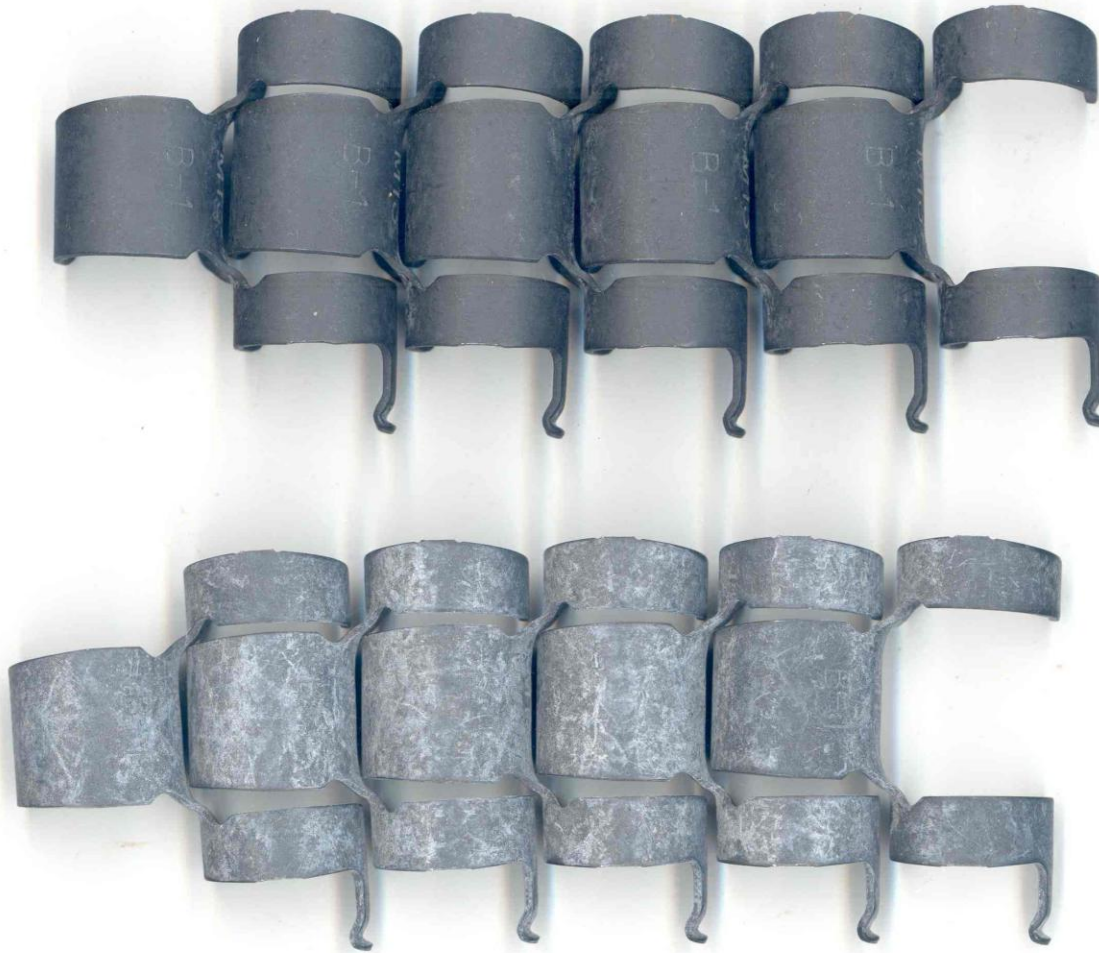
OIL-2 HOUR SALT SPRAY

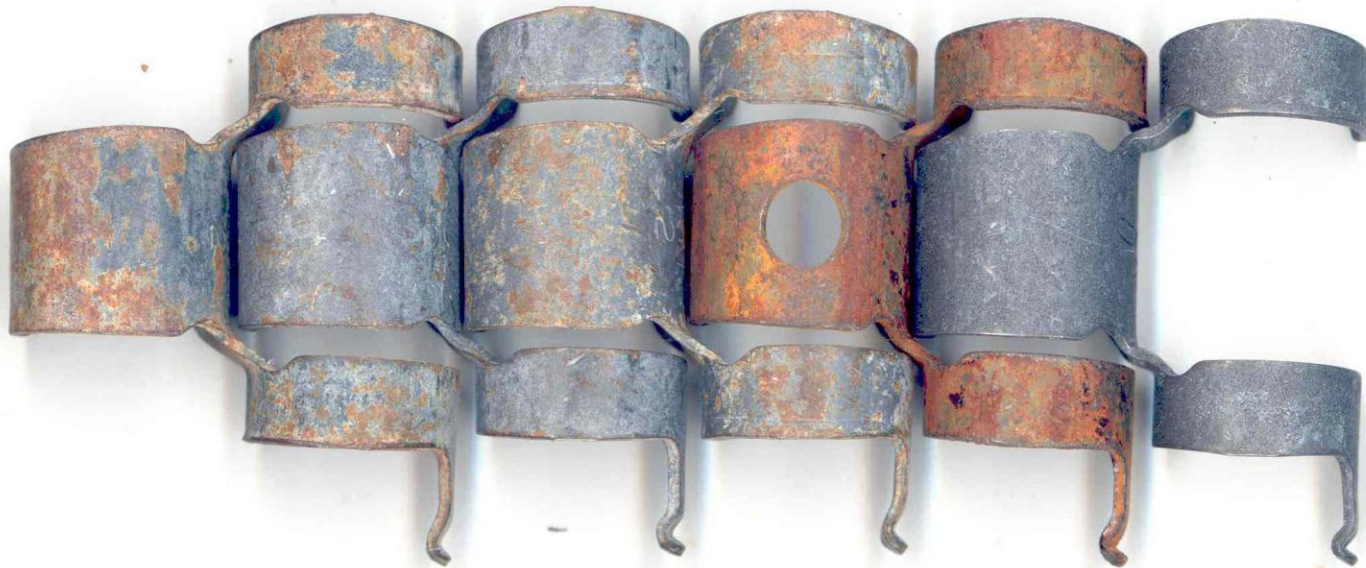


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- CURRENT WEAPON LUBRICANT (MIL-PRF-63460) MEETS THE BEST COMBINATION OF LUBRICITY, VISCOSITY AND CORROSION RESISTANCE
- PREVIOUS WEAPON LUBRICANTS NEEDED A VARIETY OF MATERIALS TO MEET OPERATIONAL REQUIREMENTS
- LUBRICANT EVALUATION STILL INCLUDES GUN FIRING TESTS WHICH HAVE BECOME INCREASINGLY EXPENSIVE
- CURRENT FIELD LUBRICANT HAS SUFFICIENT CORROSION RESISTANCE TO MINIMIZE MAINTENANCE PROBLEMS

- ARMY NEEDS A LUBRICITY TEST THAT BETTER SIMULATES WEAPON OPERATION AND USE THE TEST TO EVALUATE ALL WEAPON LUBRICANTS
- CONTINUE TO USE THE CORROSION RESISTANCE AND LOW TEMPERATURE VISCOSITY REQUIREMENTS FOR FUTURE LUBRICANTS
- ALWAYS, ALWAYS USE THE LUBRICANT RECOMMENDED IN THE FIELD MANUAL

LATEST DEFINITION OF CORROSION

DOD'S WEAPON OF MASS DESTRUCTION